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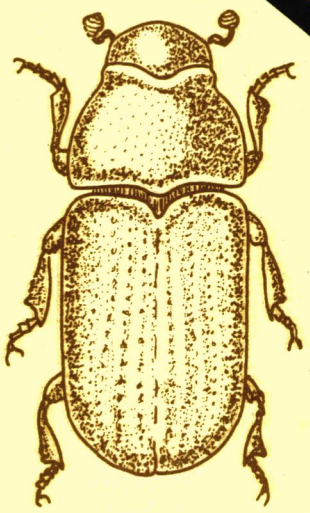
BIOLOGICAL EVALUATION
Spruce Beetle

Jemez Mountains
Santa Fe National Forest
New Mexico

1975



Southwestern Region

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

5230

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Spruce Beetle

Jemez Mountains
Santa Fe National Forest
New Mexico

November 1975

Forest Insect and Disease Management
State and Private Forestry
Southwestern Region, Forest Service, USDA
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INTRODUCTION

An extensive infestation of the spruce beetle in the Jemez Mountains of the Santa Fe National Forest was detected on August 5 and 6, 1975, during aerial reconnaissance surveys. The infestation is spread throughout the highest plateaus and mesas of the Cuba, Coyote, and Espanola Ranger Districts. The spruce beetle caused moderate losses in the mid to late 1960's in the spruce-fir forests of these Districts. Sub-zero temperatures in January 1971 reduced spruce beetle populations in standing trees, but widespread blowdown in October 1971 favored an outbreak the following year.

Portions of the infestation were surveyed between September 22 and 25, 1975, by Forest Insect and Disease Management personnel to gather data on tree losses, the green stand structure, and the spruce beetle population. These data have been summarized and are presented in this evaluation together with recommendations for managing the infestation.

TECHNICAL INFORMATION

Insect.--Spruce beetle, Dendroctonus rufipennis (Kirby)

Host.--Engelmann spruce, Picea engelmannii Parry

Location and Extent of Infestation.--The infestation is scattered over 75,000 acres in the Jemez Mountains of north central New Mexico. About half the infestation lies within the San Pedro Parks Wilderness, Santa Fe National Forest. The spruce-fir forests of the Jemez Mountains are largely virgin timber. The spruce trees are of large diameter, overmature, and occur in dense, even-aged stands. These stands represent a highly susceptible condition for the spruce beetle.

History of the Infestation

Winds in excess of 70 m.p.h. caused spruce blowdown in the Jemez Mountains during October 1971. Salvage efforts were initiated by the Santa Fe National Forest to harvest this blowdown, but only a small percentage of the damaged timber was recovered. The widely scattered nature of the blowdown made complete recovery impossible.

The wind-thrown spruce was attacked by the spruce beetle in 1972, and perhaps also in 1973, but the broods, which developed in each downed tree, were not abundant (J. Schmid, personal communication). However, the large number of trees with small numbers of emerging beetles apparently created large populations, which emerged and attacked green trees in 1974. These trees faded and became evident during the aerial reconnaissance surveys flown in August 1975.

METHODS

Survey Areas

The 1975 aerial survey maps were examined to locate accessible areas of highest tree mortality. Five such areas were surveyed (Fig. 1, Appendix): area #1 on the Cuba Ranger District; areas #2, #3, and #4 on the Coyote Ranger District; and area #5 on the Espanola Ranger District. Portions of areas #4 and #5 are shown in the photographs in Appendix Figures 2 and 3, respectively.

Data Collection

Each area was surveyed systematically with variable-radius plots using a 20 BAF. A Spiegel-Relaskop was used to measure the critical angle from each plot center. Plot centers were established at 10-chain intervals along each cruise line by hand compass and pacing. Cruise lines were 10 chains apart. The number of trees larger than 5 inches d.b.h. on each plot was tallied by species and 1-inch d.b.h. classes (e.g., 5-inch class = 5.0-5.9; 6-inch class = 6.0-6.9; etc.). Beetle-attacked spruce was further classed by the year of the infestation (i.e., new = infested in 1975, green foliage and fresh phloem with eggs or small larvae in beetle galleries; old = infested in 1974, yellow to purple green foliage and deteriorated phloem with large larvae, pupae, or adults under bark or emergence hole, and hibernating adults massed at root collar; snag = infested prior to 1974, no foliage and deteriorated phloem and bark with evidence of spruce beetle galleries, but no insects present). Partially attacked trees (i.e., those attacked in a previous year with adults present, but with green crowns) were considered as live trees. All tree measurement data were analyzed by the NSEC computer program.

The relative vigor and development of spruce beetle broods within infested trees was noted in each survey area.

RESULTS

Tree Losses

The survey data for tree losses in each area have been presented in Appendix Tables 1 to 10. A summary of these data follows:

Ranger District		Annual spruce mortality (Averages per acre) 1975	1974	Pre-1974	Total	% spruce killed	% stand killed
Cuba	Area 1 (190 A)						
	Trees/acre	1.6	2.4	2.4	6.4	5.4	3.1
	B.A.*/acre	3.2	4.2	1.0	8.4	8.8	5.9
Coyote	Area 2 (120 A)						
	Trees/acre	0	0.3	0	0.3	0.2	0.2
	B.A.*/acre	0	1.7	0	1.7	1.7	1.1
	Area 3 (100 A)						
	Trees/acre	0	0	0	0	0	0
	B.A.*/acre	0	0	0	0	0	0
	Area 4 (160 A)						
	Trees/acre	0	2.1	0	2.1	2.2	1.5
	B.A.*/acre	0	5.0	0	5.0	5.4	3.9
Espanola	Area 5 (80 A)						
	Trees/acre	3.2	22.2	1.8	27.3	20.6	7.4
	B.A.*/acre	2.5	27.5	2.5	32.5	30.2	15.6

*Square feet.

The greatest tree and basal area losses were found in survey areas 1, 4, and 5, and the lowest in areas 2 and 3. Most of the infested trees were represented by 1974 attacks, with few to no 1975 and pre-1974 attacks. This is a direct result of the large populations which developed in the 1971-wind-thrown material.

Green Stand Structure

The survey data for the green stand in each area are shown in Appendix Tables 1 to 10. These have been summarized below:

Survey tract (acreage)	Green stand					
			% spruce by size class			
			Poles	Sawtimber		
	Total stand	Total spruce	5"-11.9"	12"-15.9"	16"-19.9"	20"+
Area 1 (190 A)						
Trees/acre	198.87	111.16	63.4	12.0	17.2	7.4
B.A.*/acre	134.74	87.37	24.1	15.7	36.1	24.1
Area 2 (120 A)						
Trees/acre	184.73	121.74	69.4	13.9	5.7	11.0
B.A.*/acre	155.00	93.33	26.8	17.9	12.5	42.8
Area 3 (100 A)						
Trees/acre	202.88	89.33	33.4	26.5	28.6	11.5
B.A.*/acre	142.00	104.00	13.5	21.1	38.5	26.9
Area 4 (160 A)						
Trees/acre	145.05	93.75	48.5	33.4	10.4	7.7
B.A.*/acre	121.25	87.50	22.9	35.5	17.2	24.4
Area 5 (80 A)						
Trees/acre	339.39	104.74	61.4	24.1	8.2	6.3
B.A.*/acre	175.00	75.00	26.7	33.3	20.0	20.0

*Square feet.

Some characteristics of stands where spruce beetle outbreaks have developed in the past were recently published.1/ The characteristics were: (1) a predominance of spruce in the stand - the more spruce, the greater the potential for an outbreak; (2) BA of 150 to 200+ square feet per acre concentrated in older, large-diameter spruce; (3) single- or two-storied stands; (4) an average growth rate less than 0.04 inch per 10 years. These characteristics generally indicate stands which

1/ Schmid, J. M., and T. E. Hinds. 1974. Development of spruce-fir stands following spruce beetle outbreaks. USDA Forest Service, Res. Pap. RM-131. 16 p.

are highly susceptible to spruce beetle outbreaks if large beetle populations are present. The data collected during this evaluation provide a measure of stand susceptibility using the first two characteristics. No attempt was made to collect data on the latter two.

Spruce Beetle Populations

Spruce beetle broods in 1975-attacked trees appeared healthy and were in the egg and early larval stages. Masses of hibernating adults were common at the bases of 1974-attacked trees. These adults will fly in 1976 to attack live, susceptible spruce in the adjacent stand.

DISCUSSION

The greatest potential for tree losses in 1976 exists on the Espanola District. Large hibernating beetle populations were observed there in the stands between clearcut blocks. A high percentage of susceptible trees occur in these leave strips. The Cuba District will probably have fewer tree losses next year than the Espanola District because hibernating beetle populations are presently lower there. However, losses on the Cuba District are expected to be higher in successive years because many new attacks were found in stands with a high percentage of susceptible trees. The spruce stands of the Coyote District should experience the least losses from this infestation next year, but there is a potential for future tree losses.

CONCLUSIONS

The current spruce beetle infestation in the Jemez Mountains is a direct result of the extensive 1971 blowdown. Recent logging debris may have contributed to the infestation along with the blowdown. Abundant adult beetle populations exist in most areas examined. New attacks have produced apparently vigorous broods. Also, highly susceptible spruce trees comprise about half of each stand. Because of these two factors--large populations and a large stand component of susceptible host trees--the probability is high that the infestation will cause substantial spruce mortality during the next several years throughout the Jemez Mountains.

ALTERNATIVES

Because of the high probability that tree mortality from this infestation will continue, the following alternatives are available:

1. Individual tree treatment. Treating infested trees and stumps either chemically with ethylene dibromide (EDB) or mechanically by falling, peeling, and/or burning their bark is largely ineffective because stand conditions favoring the infestation remain unchanged. Every infested tree would have to be located and properly treated for suppression to be effective. The excessive cost and high risk of missing infested trees and/or improper timing of treatment make the success of individual tree treatment highly questionable. Additionally, a commitment to treat currently infested trees has to be made for several years. Also, this technique does not utilize the forest resource.

2. Logging for suppression. This approach is basically the same as outlined in alternative 1. While this technique makes use of the timber resource, its effectiveness is questionable. All currently infested trees along with susceptible green trees would have to be logged. The unmerchantable portions greater than 6 inches in diameter would have to be treated because leaving infested and/or green material in the forest would favor a population increase. The most susceptible stands would have to be logged on a priority basis for effective control, but this is seldom practical once an extensive outbreak begins.

3. Sanitation-salvage logging. Only currently infested trees and dead trees would be logged selectively under this alternative. The timber resource would be utilized, but little appreciable effect on the infestation would be made unless all infested trees are removed from the forest.

4. Combined techniques. Integrated suppression using all the above alternatives could be used against this infestation. Regardless of the combination, the same limitations of each individual technique still apply.

5. Do nothing. If no suppression action is taken, because costs outweigh benefits or effective suppression techniques are not practical, tree losses will have to be accepted as inevitable.

RECOMMENDATIONS

Short-Term Action

We recommend sanitation-salvage logging be initiated in those infestation areas where it is economically feasible and environmentally sound. Where economical and environmental constraints exist, no action is recommended. Because much of the infestation is inaccessible within the San Pedro Parks Wilderness, there is a high probability that even with sanitation-salvage logging, there will be no appreciable effect on the overall course of the infestation. Nevertheless, where salvage logging is conducted, the timber resource will be utilized and not lost. Where intensive salvage logging cannot be done, resource losses will have to be accepted as inevitable.

Long-Term Action

The spruce-fir forests should be put under management wherever possible to reduce their susceptibility to future spruce beetle infestations.

A P P E N D I X

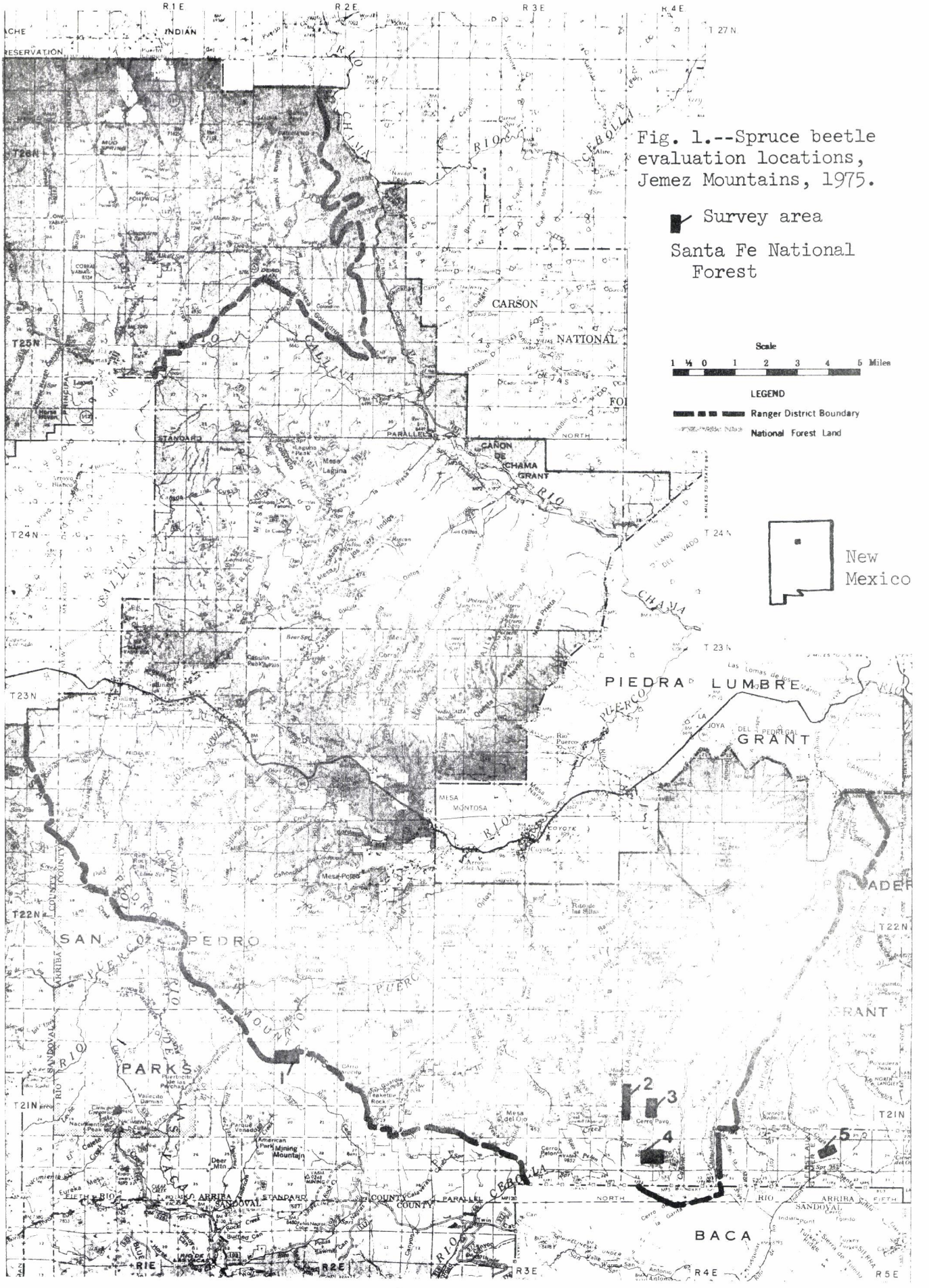

Fig. 1.--Spruce beetle evaluation locations, Jemez Mountains, 1975.

Survey area

Santa Fe National Forest

Fig. 2.--Spruce beetle infestation in survey area #4, vicinity of Cerro del Grant, Coyote RD, Santa Fe NF, 1975.

Fig. 3.--Spruce beetle infestation in survey area #5, vicinity of upper S. Fork Polvadera Creek, Espanola RD, Santa Fe NF, 1975.

Table 1

USFS INSECT SURVEY

AREA #1

POPULATION STAND TABLE
SANTA FE CUBA RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE

THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 19 PLOTS, AND REPRESENT AN AREA OF 190. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES PER ACRE

DBH	LIVE	NEW	OLD	SNAG	TOT. DEAD	PERCT. DEAD	TOTAL	PERCENTILE
5.0- 5.9	15.440	.000	.000	.000	.000	.000	15.440	13.132
6.0- 6.9	21.444	.000	.000	.000	.000	.000	21.444	18.239
7.0- 7.9	3.939	.000	.000	.000	.000	.000	3.939	3.350
8.0- 8.9	15.078	.000	.000	.000	.000	.000	15.078	12.825
9.0- 9.9	2.383	.000	.000	2.383	2.383	50.000	4.765	4.053
10.0- 10.9	5.790	.000	.000	.000	.000	.000	5.790	4.925
11.0- 11.9	6.380	.000	.000	.000	.000	.000	6.380	5.427
12.0- 12.9	1.340	.000	.000	.000	.000	.000	1.340	1.140
13.0- 13.9	4.568	.000	1.142	.000	1.142	20.000	5.710	4.857
14.0- 14.9	4.923	.000	.000	.000	.000	.000	4.923	4.188
15.0- 15.9	2.573	.000	.000	.000	.000	.000	2.573	2.189
16.0- 16.9	5.277	.000	.000	.000	.000	.000	5.277	4.489
17.0- 17.9	4.675	.000	.000	.000	.000	.000	4.675	3.976
18.0- 18.9	5.957	.596	.000	.000	.596	9.091	6.552	5.573
19.0- 19.9	3.208	.535	.000	.000	.535	14.286	3.742	3.183
20.0- 20.9	3.377	.482	.000	.000	.482	12.500	3.860	3.283
21.0- 21.9	1.751	.000	.875	.000	.875	33.333	2.626	2.233
22.0- 22.9	.798	.000	.399	.000	.399	33.333	1.196	1.017
23.0- 23.9	.730	.000	.000	.000	.000	.000	.730	.621
24.0- 24.9	.670	.000	.000	.000	.000	.000	.670	.570
25.0- 25.9	.309	.000	.000	.000	.000	.000	.309	.263
26.0- 26.9	.285	.000	.000	.000	.000	.000	.285	.243
27.0- 27.9	.265	.000	.000	.000	.000	.000	.265	.225
TOTAL	111.16	1.61	2.42	2.38	6.41	5.45	117.57	100.00
PERCENT	94.55	1.37	2.05	2.03	5.45			

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	ESTIMATED NO. OF TREES UPPER LIMIT
LIVE	111.15840	.92688205+02	.21264132+02	83.38389	.17079911+05	.25160281+05
NEW	1.61278	.51283282+01	.11765192+01	317.98151	.82888712+02	.52996600+03
OLD	2.41601	.71352314+01	.16369344+01	295.33103	.14802464+03	.77005968+03
SNAG	2.38267	.10385828+02	.23826725+01	435.88988	.56624413-05	.90541553+03
TOT. DEAD	6.41146	.12513418+02	.28707750+01	195.17270	.67272997+03	.17636245+04
TOTAL	117.56986	.97710416+02	.22416307+02	83.10839	.18079175+05	.26597371+05

Table 2

U S F S I N S E C T

S U R V E Y

A R E A # 1

POPULATION STAND TABLE
SANTA FE CUBA RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 19 PLOTS, AND REPRESENT AN AREA OF 190. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES NON-HOST TREES

N U M B E R S O F T R E E S

P E R A C R E

DBH	DOUGLAS-FIR	ALL TRUE FIR	ASPEN	OTHER	TOTAL	PERCENTILE
5.0- 5.9	.000	15.440	.000	.000	15.440	17.602
6.0- 6.9	5.361	16.083	.000	.000	21.444	24.447
7.0- 7.9	.000	19.694	.000	.000	19.694	22.452
9.0- 9.9	2.383	7.148	.000	.000	9.531	10.866
11.0- 11.9	.000	.000	1.595	.000	1.595	1.818
12.0- 12.9	.000	1.340	2.681	.000	4.021	4.584
13.0- 13.9	.000	1.142	.000	.000	1.142	1.302
14.0- 14.9	.985	.985	.000	.000	1.969	2.245
15.0- 15.9	1.716	.000	1.716	.000	3.431	3.912
16.0- 16.9	.754	1.508	.000	.000	2.262	2.578
17.0- 17.9	.668	1.336	.668	.000	2.671	3.045
18.0- 18.9	.000	.596	.000	.000	.596	.679
19.0- 19.9	.535	.535	.000	.000	1.069	1.219
20.0- 20.9	.000	.482	.000	.000	.482	.550
21.0- 21.9	.000	.438	.000	.000	.438	.499
23.0- 23.9	.000	.365	.000	.000	.365	.416
24.0- 24.9	.335	.000	.000	.000	.335	.382
25.0- 25.9	.000	.309	.000	.000	.309	.352
26.0- 26.9	.285	.000	.000	.000	.285	.325
27.0- 27.9	.265	.000	.000	.000	.265	.302
30.0- 30.9	.214	.000	.000	.000	.214	.244
35.0- 35.9	.158	.000	.000	.000	.158	.180
TOTAL	13.66	67.40	6.66	.00	87.71	100.00
PERCENT	15.57	76.84	7.59	.00	100.00	

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	UPPER LIMIT
DOUGLAS-FIR	13.65749	.32993581+02	.75692466+01	241.57860	.11567668+04	.40330805+04
ALL TRUE FIR	67.39865	.11683468+03	.26803715+02	173.34871	.77130370+04	.17898448+05
ASPEN	6.65885	.13557829+02	.31103794+01	203.60615	.67420954+03	.18561537+04
OTHER	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	87.71499	.11686210+03	.26810004+02	133.22934	.11571947+05	.21759748+05

Table 3

USFS INSECT

SURVEY

AREA #2

POPULATION STAND TABLE
SANTA FE COYOTE RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE

THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 12 PLOTS, AND REPRESENT AN AREA OF 120. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES PER ACRE

DBH	LIVE	NEW	OLD	SNAG	TOT. DEAD	PERCT. DEAD	TOTAL	PERCENTILE
5.0- 5.9	12.223	.000	.000	.000	.000	.000	12.223	10.016
6.0- 6.9	33.953	.000	.000	.000	.000	.000	33.953	27.822
7.0- 7.9	12.473	.000	.000	.000	.000	.000	12.473	10.220
8.0- 8.9	4.775	.000	.000	.000	.000	.000	4.775	3.912
9.0- 9.9	3.773	.000	.000	.000	.000	.000	3.773	3.091
10.0- 10.9	12.223	.000	.000	.000	.000	.000	12.223	10.016
11.0- 11.9	5.051	.000	.000	.000	.000	.000	5.051	4.139
12.0- 12.9	6.366	.000	.000	.000	.000	.000	6.366	5.217
13.0- 13.9	3.616	.000	.000	.000	.000	.000	3.616	2.963
14.0- 14.9	1.559	.000	.000	.000	.000	.000	1.559	1.278
15.0- 15.9	5.432	.000	.000	.000	.000	.000	5.432	4.451
16.0- 16.9	1.194	.000	.000	.000	.000	.000	1.194	.978
17.0- 17.9	3.172	.000	.000	.000	.000	.000	3.172	2.599
19.0- 19.9	2.539	.000	.000	.000	.000	.000	2.539	2.081
20.0- 20.9	3.056	.000	.000	.000	.000	.000	3.056	2.504
21.0- 21.9	2.772	.000	.000	.000	.000	.000	2.772	2.271
22.0- 22.9	.631	.000	.000	.000	.000	.000	.631	.517
23.0- 23.9	1.733	.000	.000	.000	.000	.000	1.733	1.420
24.0- 24.9	2.122	.000	.000	.000	.000	.000	2.122	1.739
25.0- 25.9	.978	.000	.000	.000	.000	.000	.978	.801
27.0- 27.9	.838	.000	.000	.000	.000	.000	.838	.687
29.0- 29.9	.363	.000	.000	.000	.000	.000	.363	.298
31.0- 31.9	.318	.000	.000	.000	.000	.000	.318	.261
32.0- 32.9	.298	.000	.298	.000	.298	50.000	.597	.489
33.0- 33.9	.281	.000	.000	.000	.000	.000	.281	.230
TOTAL	121.74	.00	.30	.00	.30	.24	122.04	100.00
PERCENT	99.76	.00	.24	.00	.24			

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	UPPER LIMIT
LIVE	121.73958	.15735300+03	.45423900+02	129.25377	.91578818+04	.20059618+05
NEW	.00000	.00000000	.00000000	.00000	.00000000	.00000000
OLD	.29842	.10337425+01	.29841576+00	346.41016	.44703484-06	.71619782+02
SNAG	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOT. DEAD	.29842	.10337422+01	.29841566+00	346.41015	.44703484-06	.71619758+02
TOTAL	122.03800	.15744779+03	.45451263+02	129.01538	.91904082+04	.20098711+05

Table 4

USFS INSECT

SURVEY

AREA #2

POPULATION STAND TABLE
SANTA FE COYOTE RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE

THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 12 PLOTS, AND REPRESENT AN AREA OF 120. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES PER ACRE

DBH	DOUGLAS-FIR	ALL TRUE FIR	ASPEN	OTHER	TOTAL	PERCENTILE
5.0- 5.9	.000	.000	12.223	.000	12.223	19.406
7.0- 7.9	6.236	.000	.000	.000	6.236	9.901
8.0- 8.9	.000	.000	4.775	.000	4.775	7.580
9.0- 9.9	.000	3.773	.000	.000	3.773	5.989
10.0- 10.9	.000	.000	3.056	.000	3.056	4.851
11.0- 11.9	.000	.000	5.051	.000	5.051	8.019
12.0- 12.9	2.122	.000	.000	.000	2.122	3.369
13.0- 13.9	1.808	.000	3.616	.000	5.424	8.612
14.0- 14.9	.000	.000	3.118	.000	3.118	4.950
15.0- 15.9	.000	.000	1.358	.000	1.358	2.156
16.0- 16.9	2.387	.000	4.775	.000	7.162	11.371
17.0- 17.9	1.057	.000	.000	.000	1.057	1.679
18.0- 18.9	.943	.000	.000	.000	.943	1.497
19.0- 19.9	1.693	.000	.000	.000	1.693	2.688
20.0- 20.9	.000	.000	.764	.000	.764	1.213
22.0- 22.9	.631	.000	.000	.000	.631	1.002
23.0- 23.9	.578	.000	.000	.000	.578	.917
24.0- 24.9	.531	.000	.000	.000	.531	.842
26.0- 26.9	.452	.000	.000	.000	.452	.718
27.0- 27.9	.419	.000	.000	.000	.419	.665
30.0- 30.9	.340	.000	.000	.000	.340	.539
31.0- 31.9	.318	.000	.000	.000	.318	.505
36.0- 36.9	.236	.000	.000	.000	.236	.374
37.0- 37.9	.223	.000	.000	.000	.223	.354
39.0- 39.9	.201	.000	.000	.000	.201	.319
43.0- 43.9	.165	.000	.000	.000	.165	.262
47.0- 47.9	.138	.000	.000	.000	.138	.220
TOTAL	20.48	3.77	38.74	.00	62.99	100.00
PERCENT	32.51	5.99	61.50	.00	100.00	

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	ESTIMATED NO. OF TREES UPPER LIMIT
DOUGLAS-FIR	20.47903	.25652787+02	.74053218+01	125.26366	.15688454+04	.33461226+04
ALL TRUE FIR	3.77256	.13068548+02	.37725647+01	346.41016	.35762787-05	.90541553+03
ASPEN	38.73558	.69670076+02	.20112019+02	179.86069	.22348268+04	.70617113+04
OTHER	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	62.98717	.99689401+02	.28777851+02	158.26937	.41051187+04	.11011803+05

Table 5

USFS INSECT SURVEY
AREA #3

POPULATION STAND TABLE
SANTA FE COYOTE RD 1975
HOST SPECIES IS ENGLEMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 10 PLOTS, AND REPRESENT AN AREA OF 100. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES HOST TREES

NUMBERS OF TREES PER ACRE

DBH	LIVE	NEW	OLD	SNAG	TOT. DEAD	PERCT. DEAD	TOTAL	PERCENTILE
7.0- 7.9	7.484	.000	.000	.000	.000	.000	7.484	8.377
8.0- 8.9	5.730	.000	.000	.000	.000	.000	5.730	6.414
9.0- 9.9	4.527	.000	.000	.000	.000	.000	4.527	5.068
11.0- 11.9	12.122	.000	.000	.000	.000	.000	12.122	13.569
12.0- 12.9	10.186	.000	.000	.000	.000	.000	10.186	11.402
13.0- 13.9	4.340	.000	.000	.000	.000	.000	4.340	4.858
14.0- 14.9	7.484	.000	.000	.000	.000	.000	7.484	8.377
15.0- 15.9	1.630	.000	.000	.000	.000	.000	1.630	1.824
16.0- 16.9	12.892	.000	.000	.000	.000	.000	12.892	14.431
17.0- 17.9	3.807	.000	.000	.000	.000	.000	3.807	4.261
18.0- 18.9	6.791	.000	.000	.000	.000	.000	6.791	7.601
19.0- 19.9	2.032	.000	.000	.000	.000	.000	2.032	2.274
20.0- 20.9	4.584	.000	.000	.000	.000	.000	4.584	5.131
21.0- 21.9	.832	.000	.000	.000	.000	.000	.832	.931
22.0- 22.9	1.515	.000	.000	.000	.000	.000	1.515	1.696
23.0- 23.9	1.386	.000	.000	.000	.000	.000	1.386	1.552
24.0- 24.9	.637	.000	.000	.000	.000	.000	.637	.713
26.0- 26.9	.542	.000	.000	.000	.000	.000	.542	.607
29.0- 29.9	.436	.000	.000	.000	.000	.000	.436	.488
31.0- 31.9	.382	.000	.000	.000	.000	.000	.382	.427
TOTAL	89.33	.00	.00	.00	.00	.00	89.33	100.00
PERCENT	100.00	.00	.00	.00	.00			

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	UPPER LIMIT
LIVE	89.33474	.5117503E+02	.1618296E+02	57.28458	.7315177E+04	.1055177E+05
NEW	.00000	.00000000	.00000000	.00000	.00000000	.00000000
OLD	.00000	.00000000	.00000000	.00000	.00000000	.00000000
SNAG	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOT. DEAD	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	89.33474	.5117503E+02	.1618296E+02	57.28458	.7315177E+04	.1055177E+05

Table 6

USFS INSECT

SURVEY

AREA #3

POPULATION STAND TABLE
SANTA FE COYOTE RD 1975
HOST SPECIES IS ENGLEMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 10 PLOTS, AND

REPRESENT AN AREA OF 100. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES

PER ACRE

DBH	DOUGLAS-FIR	ALL TRUE FIR	ASPEN	OTHER	TOTAL	PERCENTILE
5.0- 5.9	.000	29,335	.000	.000	29,335	25,834
6.0- 6.9	.000	20,372	10,186	.000	30,558	26,911
7.0- 7.9	.000	7,484	7,484	.000	14,967	13,181
8.0- 8.9	.000	5,730	5,730	.000	11,459	10,091
9.0- 9.9	.000	.000	4,527	.000	4,527	3,987
10.0- 10.9	.000	.000	3,667	.000	3,667	3,229
11.0- 11.9	.000	.000	9,092	.000	9,092	8,006
13.0- 13.9	.000	4,340	4,340	.000	8,679	7,643
17.0- 17.9	.000	.000	1,269	.000	1,269	1,117
TOTAL	.00	67,26	46,29	.00	113,55	100,00
PERCENT	.00	59,23	40,77	.00	100,00	

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	UPPER LIMIT
DOUGLAS-FIR	.00000	.00000000	.00000000	.00000	.00000000	.00000000
ALL TRUE FIR	67,26000	.9178081E+02	.2902364E+02	136,45676	.3823635E+04	.9628363E+04
ASPEN	46,29302	.7613068E+02	.2407463E+02	164,45390	.2221838E+04	.7036765E+04
OTHER	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	113,55302	.1310800E+03	.4145115E+02	115,43512	.7210186E+04	.1550041E+05

Table 7

U S F S I N S E C T

S U R V E Y

A R E A # 4

POPULATION STAND TABLE
SANTA FE CUYOTE RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE

THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 16 PLOTS, AND REPRESENT AN AREA OF 160. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES HOST TREES

N U M B E R S O F T R E E S

P E R A C R E

DBH	LIVE	NEW	OLD	SNAG	TOT. DEAD	PERCT. DEAD	TOTAL	PERCENTILE
6.0- 6.9	12.732	.000	.000	.000	.000	.000	12.732	13.276
8.0- 8.9	3.581	.000	.000	.000	.000	.000	3.581	3.734
9.0- 9.9	11.318	.000	.000	.000	.000	.000	11.318	11.801
10.0- 10.9	4.584	.000	.000	.000	.000	.000	4.584	4.780
11.0- 11.9	13.259	.000	.000	.000	.000	.000	13.259	13.825
12.0- 12.9	7.958	.000	.000	.000	.000	.000	7.958	8.298
13.0- 13.9	5.424	.000	.000	.000	.000	.000	5.424	5.656
14.0- 14.9	12.862	.000	.000	.000	.000	.000	12.862	13.413
15.0- 15.9	5.093	.000	.000	.000	.000	.000	5.093	5.311
16.0- 16.9	5.371	.000	.000	.000	.000	.000	5.371	5.601
17.0- 17.9	2.379	.000	.000	.000	.000	.000	2.379	2.481
18.0- 18.9	.707	.000	1.415	.000	1.415	66.667	2.122	2.213
19.0- 19.9	1.270	.000	.000	.000	.000	.000	1.270	1.324
20.0- 20.9	1.719	.000	.000	.000	.000	.000	1.719	1.792
21.0- 21.9	1.039	.000	.000	.000	.000	.000	1.039	1.084
22.0- 22.9	.947	.000	.000	.000	.000	.000	.947	.988
23.0- 23.9	.433	.000	.000	.000	.000	.000	.433	.452
24.0- 24.9	1.989	.000	.000	.000	.000	.000	1.989	2.074
25.0- 25.9	.367	.000	.733	.000	.733	66.667	1.100	1.147
29.0- 29.9	.273	.000	.000	.000	.000	.000	.273	.284
31.0- 31.9	.238	.000	.000	.000	.000	.000	.238	.249
33.0- 33.9	.210	.000	.000	.000	.000	.000	.210	.219
TOTAL	93.75	.00	2.15	.00	2.15	2.24	95.90	100.00
PERCENT	97.76	.00	2.24	.00	2.24			

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	ESTIMATED NO. OF TREES UPPER LIMIT
LIVE	93.75452	.10855655+03	.27139137+02	115.78806	.10658462+05	.19542986+05
NEW	.00000	.00000000	.00000000	.00000	.00000000	.00000000
OLD	2.14810	.62484671+01	.15621168+01	290.88366	.93757052+02	.59363441+03
SNAG	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOT. DEAD	2.14810	.62484671+01	.15621168+01	290.88366	.93757057+02	.59363442+03
TOTAL	95.90262	.10776085+03	.26940213+02	112.36487	.11033985+05	.19654854+05

Table 8

USFS INSECT

SURVEY

AREA #4

POPULATION STAND TABLE
SANTA FE COYOTE ND 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 16 PLOTS, AND REPRESENT AN AREA OF 160. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES PER ACRE

DBH	DOUGLAS-FIR	ALL TRUE FIR	ASPEN	OTHER	TOTAL	PERCENTILE
6.0- 6.9	.000	6.366	.000	.000	6.366	12.411
7.0- 7.9	.000	4.677	.000	.000	4.677	9.118
8.0- 8.9	.000	3.581	.000	.000	3.581	6.981
9.0- 9.9	.000	11.318	2.829	.000	14.147	27.579
10.0- 10.9	.000	2.292	2.292	.000	4.584	8.936
12.0- 12.9	.000	1.592	.000	.000	1.592	3.103
13.0- 13.9	.000	4.068	5.424	.000	9.493	18.506
14.0- 14.9	.000	.000	2.339	.000	2.339	4.559
16.0- 16.9	.000	1.790	.000	.000	1.790	3.490
18.0- 18.9	.000	.707	.000	.000	.707	1.379
19.0- 19.9	.000	.635	.000	.000	.635	1.238
20.0- 20.9	.000	.573	.000	.000	.573	1.117
22.0- 22.9	.000	.000	.474	.000	.474	.923
26.0- 26.9	.000	.339	.000	.000	.339	.661
TOTAL	.00	37.94	13.36	.00	51.30	100.00
PERCENT	.00	73.96	26.04	.00	100.00	

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	ESTIMATED NO. OF TREES UPPER LIMIT
DOUGLAS-FIR	.00000	.00000000	.00000000	.00000	.00000000	.00000000
ALL TRUE FIR	37.93852	.5506429I+02	.13766073+02	145.14086	.3867591I+04	.8272734I+04
ASPEN	13.35784	.2874100+02	.7185251O+01	215.16209	.9876139I+03	.5286894Z+04
OTHER	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	51.29635	.5345694+02	.13364237+02	104.21198	.6069138+04	.1034569+05

Table 9

U S F S I N S E C T

S U R V E Y

A R E A # 5

POPULATION STAND TABLE
SF ESPANOLA RD 1975
MOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 8 PLOTS, AND

REPRESENT AN AREA OF 80. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES MOST TREES

N U M B E R S O F T R E E S

P E R A C R E

DBH	LIVE	NEW	OLD	SNAG	TOT. DEAD	PERCT. DEAD	TOTAL	PERCENTILE
5.0- 5.9	18.335	.000	.000	.000	.000	.000	18.335	13.893
7.0- 7.9	18.709	.000	.000	.000	.000	.000	18.709	14.176
8.0- 8.9	14.324	.000	.000	.000	.000	.000	14.324	10.854
10.0- 10.9	9.167	.000	.000	.000	.000	.000	9.167	6.946
11.0- 11.9	3.788	.000	3.788	.000	3.788	50.000	7.576	5.741
12.0- 12.9	12.732	3.183	.000	.000	3.183	20.000	15.916	12.060
13.0- 13.9	.000	.000	8.157	.000	8.157	100.000	8.157	6.165
14.0- 14.9	2.339	.000	.000	.000	.000	.000	2.339	1.772
15.0- 15.9	10.186	.000	4.074	.000	4.074	28.571	14.260	10.805
16.0- 16.9	1.790	.000	1.790	1.790	3.581	66.667	5.371	4.070
17.0- 17.9	1.586	.000	1.586	.000	1.586	50.000	3.172	2.404
18.0- 18.9	1.415	.000	.000	.000	.000	.000	1.415	1.072
19.0- 19.9	3.809	.000	.000	.000	.000	.000	3.809	2.886
20.0- 20.9	3.438	.000	1.146	.000	1.146	25.000	4.584	3.473
21.0- 21.9	3.118	.000	.000	.000	.000	.000	3.118	2.363
22.0- 22.9	.000	.000	.947	.000	.947	100.000	.947	.718
24.0- 24.9	.000	.000	.796	.000	.796	100.000	.796	.603
TOTAL	104.74	3.18	22.26	1.79	27.24	20.64	131.97	100.00
PERCENT	79.36	2.41	16.87	1.36	20.64			

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	UPPER LIMIT
LIVE	104.73616	.71334381+02	.25220512+02	68.10864	.63612521+04	.1039653+05
NEW	3.18310	.90031706+01	.31831015+01	282.84271	.00000000	.5092962+03
OLD	22.26448	.33821318+02	.11957642+02	151.90708	.8245468+03	.2737769+04
SNAG	1.79049	.50642835+01	.17904946+01	282.84271	.00000000	.2864791+03
TOT. DEAD	27.23807	.32848583+02	.11613728+02	120.59804	.1249947+04	.3108144+04
TOTAL	131.97424	.97659853+02	.34527972+02	73.99918	.7795701+04	.1332017+05

Table 10

USFS INSECT SURVEY
AREA #5

POPULATION STAND TABLE
SF ESPANOLA RD 1975
HOST SPECIES IS ENGELMANN SPRUCE

THE INSECT NAME IS E. SPRUCE BEETLE

THE METHOD OF SAMPLING WAS VARIABLE

THE FIGURES IN THIS TABLE ARE BASED ON A SAMPLE OF 8 PLOTS, AND REPRESENT AN AREA OF 80. ACRES.

BAF WAS 20.

THIS TABLE ONLY INCLUDES NON-HOST TREES

NUMBERS OF TREES PER ACRE

DBH	DOUGLAS-FIR	ALL TRUE FIR	ASPEN	OTHER	TOTAL	PERCENTILE
5.0- 5.9	.000	73.339	.000	.000	73.339	31.255
6.0- 6.9	.000	25.465	.000	.000	25.465	10.852
7.0- 7.9	.000	9.354	.000	.000	9.354	3.987
8.0- 8.9	.000	14.324	21.486	.000	35.810	15.261
9.0- 9.9	.000	28.294	11.318	.000	39.612	16.881
11.0- 11.9	.000	.000	3.788	.000	3.788	1.614
12.0- 12.9	.000	6.366	3.183	.000	9.549	4.070
13.0- 13.9	.000	16.273	.000	.000	16.273	6.935
14.0- 14.9	.000	.000	7.016	.000	7.016	2.990
15.0- 15.9	.000	2.037	2.037	.000	4.074	1.736
16.0- 16.9	.000	3.581	5.371	.000	8.952	3.815
18.0- 18.9	1.415	.000	.000	.000	1.415	.603
TOTAL	1.41	179.03	54.20	.00	234.65	100.00
PERCENT	.60	76.30	23.10	.00	100.00	

	AVE. NO. OF TREES PER ACRE	STANDARD DEVIATION	STANDARD ERROR	COEFFICIENT OF VARIATION	ESTIMATED NO. OF TREES LOWER LIMIT	ESTIMATED NO. OF TREES UPPER LIMIT
DOUGLAS-FIR	1.41471	.40014092+01	.14147118+01	282.84271	.00000000	.22635389+03
ALL TRUE FIR	179.03382	.17906783+03	.63310037+02	100.01899	.92579031+04	.19387509+05
ASPEN	54.19937	.10344826+03	.36574482+02	190.86617	.14099909+04	.72619080+04
OTHER	.00000	.00000000	.00000000	.00000	.00000000	.00000000
TOTAL	234.64791	.18948097+03	.66991638+02	80.75119	.13412501+05	.24131163+05